CHEMISTRY

BOOKS - PEARSON IIT JEE FOUNDATION

CHEMICAL KINETICS AND EQUILIBRIUM

Example

1. On the basis of collision theory, explain the action of a catalyst on the rate of reaction

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2. Hydrogen peroxide decomposes to water abd oxygen. The uncatalysed reaction has activation energy of 86 KJ/mol. The activation energy value in the presence of acetanilide is 112 KJ/mol and in the presence of MnO_2 it is 49 KJ/mol . What conclusion can you draw from the above observations ?

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3. Assuming that $2NO + O_2 \rightarrow 2NO_2$ is a single-step reaction, what will be the rate of reaction when the volume of the reaction vessel is reduced of $1/4^{th}$ of the initial value ? The original rate of reaction is 64 mol/L/s.

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4. When two moles of hydrogen are heated with two moels of iodine, 2.96 moles of hydrogen iodide are formed. Calculate K_c for the reaction of formation of hydrogen iodide.

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5. Calculate K_p for the following reaction if partial pressures of NH_3, N_2 and H_2 are 0.4,0.3,0.2, atm, respectively.

$2NH_3 \Leftrightarrow N_2 + 3H_2$

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6. For reaction HI $\Leftrightarrow 1/2H_2 + 1/2I_2$ value of K_c is $1/8$, then value of K_c for $H_2 + I_2 \Leftrightarrow 2HI$.

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7. In the reaction $N_2O_4 \Leftrightarrow 2NO_2$, the dissociation of N_2O was found to be 40 per cent at equilibrium when the reaction is conducted in a 2 L container at 300 K. Find the equilibrium constant and the number of moles of reactants and products.

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8. (I) What is the effect of pressure on the equilibrium of the reaction between nitrogen and oxygen to give nitric oxide ?

(II) In a reversible reaction, some amount of heat energy is liberated in th forward reaction. Name the reaction . What change in temperature favours the forward reaction ?

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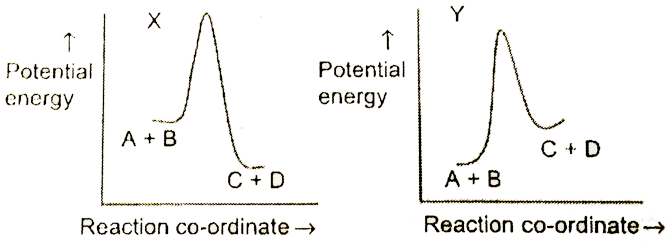
9. A teacher, while revising asked Raman and Bose to sketch a potential energy diagram for a reaction $A + B \Leftrightarrow C + D$. ΔH for the reverse reaction is -10 KJ and E_a of the forward reaction is 40 KJ. The graphs drawn by both of them are X and Y, respectively . Between X and Y, which graph is correct and why ? Also, explain why the

other one is wrong.



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10. During the preparation of soap the addition of common salt allows the precipitation of soap . Expalin the principle involved (Soap is the sodium salt of carboxylic acid).

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Very Short Answer Type Questions

1. Define instantaneous reactions.

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2. What are the units of rate of reaction ?

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3. The equation that describes mathematically the dependence of the rate of rection on the concentration terms of reactant is _____ or _____.

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4. For a reaction $A \rightarrow B$, ΔC_B is 0.01 mol/L is 20 s, what is the average rate of reaction ?

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5. The reaction between Zn and H_2SO_4 is an example for _____ reaction.

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6. The activation energy for an uncatalysed reaction is less than that for a catalysed reaction. What do you conclude from the above statement ?

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7. A ____ does not change the position of equilibrium but_____ the rate of backward as well as forward reaction.

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8. Give the general expression for a balanced chemical equation by applying the law of mass action.

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9. When the reaction of synthesis of ammonia is carried out with a mixture of hydrogen and deuterium , what are the products obtained at the end of the process

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10. Write the equilibrium constant for the dissociation of $CaCO_3$.

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11. In the reaction $A + B \rightarrow C, rk[A],$ if [A] is increased by three then the difference in the rate is _____ of the initial rate.

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12. What are the effective collisions ?

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13. _____ enables any two systems to reach a state of equilibrium more quickly.

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14. Define a reversible reaction. Give an example.

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15. What is meant by specific reaction rate ?

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16. The value of equilibrium constant for a reversible reaction is 3×10^{-2} . If the reaction quotient for the same reaction is 5×10^{-3} , predict the direction of equilibrium reaction.

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17. In the reaction $2NO_g + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O$, if initial concentration of hydrogen is kept constant and the concentration of NO is doubled , the rate of reaction increases by four times. This shows that rate is directly proportional to _____.

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18. The equilibrium $H_{2(g)} + I_{2(g)} \Leftrightarrow 2HI_g$ is not affected by the change in _____.

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19. What is the effect of catalyst on the equilibrium state in a chemical reaction ?

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20. Active mass of a solid is taken as _____ .

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21. Ammonia dissociates to give nitrogen and hydrogen . What happens if the pressure is increased on the system at equilibrium ?

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22. What are the units for the rate of the reaction $A \rightarrow B$?

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23. If K_c for the formation of HI from H_2 and I_2 is 48, then K_c for decomposition of 1 mole of HI is _____.

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24. The magnitude of _____ decreases in the presence of catalyst.

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25. Give the units the K_c for the formation of 1 mole of NH_3 from its constituents .

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26. The chemical equilibrium is ..... in nature.

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Short Answer Type Questions

1. How are the reactions classified on the basis of rates of reactions ? Give examples.

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2. What is the effect of temperature on the rate of a reaction.

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3. Define reversible and irreversible reactions. Give examples.

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4. Discuss how the chemical equilibrium is dynamic by giving graphical representation.

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5. What are the charactersitics of dynamic equilibrium ?

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6. How is it possible to make reversible reaction irreversible?

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7. Apply the law of mass action to the following equilibria :

(i) Formation of SO_3 from SO_2 and O_2

(ii) Formation of NO_2 from nitric oxide and oxygen

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8. How does a catalyst influence the equilibrium constant ?

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9. Product the shift in equilibrium when the volume is decreased on the following equilibrium reactions :

(i) $PCl_{3(g)} + Cl_{2(g)} \Leftrightarrow PCl_{5(g)}$

(ii) $N_{2(g)} + O_{2(g)} \Leftrightarrow 2NO_{(g)}$

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10. What are the applications of equilibrium constant ?

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Essay Type Questions

1. State and explain the law of mass action. Apply it to the following equilibria:

(i) $H_{2(g)} + F_{2(g)} \Leftrightarrow 2HF_g$

$(ii) NH_4HS_S \Leftrightarrow NH_{3(g)} + H_2S_g$

(iii) $PCl_{5(s)} \Leftrightarrow PCl_{3(l)} + Cl_{2(g)}$

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Level 1

1. If the rate with respect to O_2, NO and NO_2 are respectively $\frac{-\Delta[O_2]}{\Delta t}, \frac{-1}{2}, \frac{\Delta[NO]}{\Delta t}, \frac{+1}{2}\frac{\Delta[NO_2]}{\Delta t}$ then the corresponding chemical equation is $2NO + O_2 \rightarrow 2NO_2$

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2. The slope obtained by drawing a tangent at time 't' on the curve for the concentration of reactants vs time is equal to instantaneous rate.

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3. In an equilibrium , the catalyst increases th rate of the forward reaction while decreases the rate of the backward reaction.

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4. Threshold energy =energy of normal molecules + Activation energy.

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5. An increase in pressure increase the rate of reaction due to the increase in the number of collisions among the molecules .

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6. In the reactio : $NO_2 + CO \Leftrightarrow NO + CO_2$, the equilibrium state may be recognised by the constancy of colour.

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7. At equilibrium the reaction quotient is greater than equilibrium constant.

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8. Equilibrium constant has a definite value for every reaction at a given temperature . It is independent of _____

and _____.

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9. The minimum energy that two molecules should possess so that their collisions result in a chemical reaction is called ____ energy.

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10. Decomposition of phosphorous pentachloride is an example of _____ equilibria.

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11. K_c changes with change in _____.

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12. _____ in temperature favours an endothermic reaction.

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13. The equilibrium constant of a reaction $A + B \Leftrightarrow 2C$ if the concentrations of A and B together is 0.8 moles L^{-1} and that of C is 0.6 mol L^{-1} is _____

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14. If K_C for the formatiion of ammonia is 2 $mol^{-2}L^2$, K_c for decoposition of ammonia is _____.

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15. If $r = \frac{-3}{2}\frac{\Delta[A]}{\Delta t} = \frac{-5}{2}\frac{\Delta[B]}{\Delta t} = \frac{+7}{3}\frac{[\Delta C]}{\Delta t}$, which of the following is the corresponding reaction ?

A. 2/3 A + 2/5 B $\rightarrow$ 3/7 C

B. 2/3 A +5/2 B $\rightarrow$ 7/3 C

C. 3/2A + 5/2B $\rightarrow$ 7/3C

D. 7/3C + 5/2 B $\rightarrow$ 3/2A

Answer: A

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16. In the reaction $N_2 + O_2 \Leftrightarrow 2NO -$ Heat , which of following conditions is suitable to get a good yield of NO ?

A. Increase in temperature

B. Decrease in temperature

C. Increase in pressure

D. The addition of a catalyst

Answer: A

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17. Which of the following is true ?

A. In an endothermic equilibrium reaction, activation energy required for a forward reaction is higher than that for a backward reaction.

B. To an endothermic reaction, activation energy required to forward reaction is lower than that for a backward reaction.

C. Activation energy required for both forward and backward reactions is same in equilibrium.

D. No activation energy is required for an exothermic backward equilibrium reaction.

Answer: A

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18. The equilibrium constant for the given reaction,

$CaCO_{3(g)} \rightarrow CaO_s + CO_{2(g)}$ is given by :

A. $K_c = \dfrac{[CaO] \cdot [CO_2]}{[CaCo_3]}$

B. $K_c = \dfrac{[CaO]}{[CaCO_3]}$

C. $K_c = [CO_2]$

D. $K_c = \dfrac{[CaO]}{[CO_2]}$

Answer: C

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19. For the chemical reaction to occur

A. the reaching molecules must collide with ecah other

B. reacting molecules should have sufficient enegy at the tie of collision.

C. reacting molecules must be properly oriented

D. all of the above

Answer: D

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20. If an activated complex is formed in chemical reactions according to the collision theory, which of the following is true with respect to its stability ?

A. It is highly stable because it has high energy

B. it is less stable because it has lower eneryg

C. It is less stable because it has high energy

D. None of the above

Answer: C

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21. The equilibrium constant for the reaction $N_{2_g} + O_{2_g} \Leftrightarrow 2NO_g$ and $NO_g \Leftrightarrow + \frac{1}{2}N_{2(g)} + \frac{1}{2}O_{2(g)}$ are k and K^1, respectively, the relation between k and k^1 is

A. $k = \left(k^1\right)^2$

B. $k = \left(\frac{1}{k^1}\right)^2$

C. $k^2 = k^1$

D. $k^1 = \left(\frac{1}{k}\right)^2$

Answer: B

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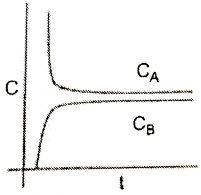
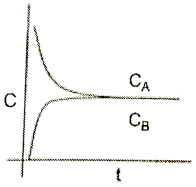
22. With respect to the equilibrium reaction $A \Leftrightarrow B$. Which of the following graphs indicate the highest K_c value ?

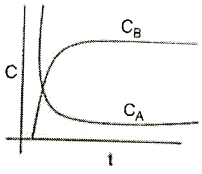
A.

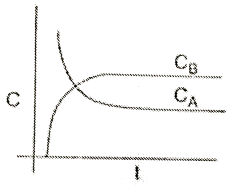


B.



C.





D.

Answer: C

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23. Equlibrium position of which of the following reactions is not affected by change in pressure ?

A. $I_{2(s)} + 5F_{2(g)} \rightarrow 2IF_{5(g)}$

B. $FeO_{(s)} + CO_{(g)} \rightarrow Fe_{(s)} + CO_{(g)}$

C.

$$2Cu(NO_3)_{2(s)} \rightarrow 2CuO_{(s)} + 4NO_{2(g)} + O_{2((g))}$$

D. $N_2O_{4(g)} \rightarrow 2NO_{2(g)}$

Answer: B

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24. The equilibrium constant K_c is 10^2 for the reaction

$AB + C \Leftrightarrow AC + B$

The rate constant for the forward reaction K is 10^6, the rate constant of backward reaction is

A. 10^4

B. 10^8

C. 10^{-4}

D. $\frac{1}{100}$

Answer: A

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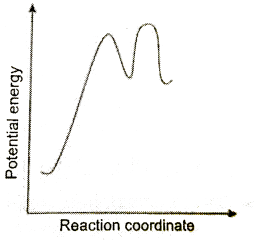
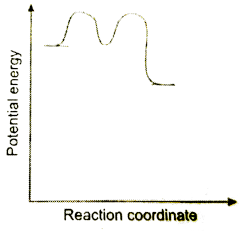
25. Which among the following is the graphical representation of a reaction is the ΔH for the forward reaction is twice the activation energy of the I step and activation energy of the II step is half of the I step

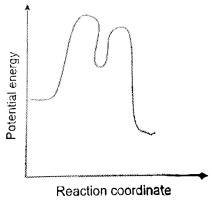
A.



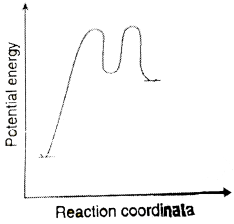
B.



C.



D.



Answer: C

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26. $2SO_{2(g)} + O_{2(g)} \Leftrightarrow 2SO_{3(g)} + Q$ KJ

In the above reaction, how can the yield of product be increased without increasing the pressure ?

A. by increasing temperature

B. by decreasing temperature

C. by increasing th volume of the reaction vessel

D. by the addition of the catalyst

Answer: B

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27. For a reaction $2A + B \rightarrow 2AB$, it is found that doubling the concentration of both the reactants increases the rate to eight times that of initial rate but doubling the concentration of B alone doubles the rate. Then the order of the reaction with respect to A and B is

A. 0,3

B. 0,2

C. 2,1

D. 2,2

Answer: C

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28. In the reaction $N_2O_4 \Leftrightarrow 2NO_2$, the degree of dissociation of N_2O_4 increases with the

A. increase in pressure

B. Decrease in temperature

C. increase in volume

D. presence of catalyst

Answer: C

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29. Identify the correct sequence of steps in an experiment to show the effect of temperature on the rate of the reaction.(1) Measuring the volumes of H_2 gas liberated in the two test tubes.

(2) Heating the test tube B by $10^\circ C$

(3) Comparison of relative volumes of H_2 liberated in test tubes B and A.

(4) Addition of same concentration of HCl ot the two test tubes.

(5) Taking equal masses of fine granules of zinc in two test tubes A and B.

A. 3,4,5,1,2

B. 5,4,2,1,3

C. 2,1,3,5,4

D. 5,4,2,3,1

Answer:

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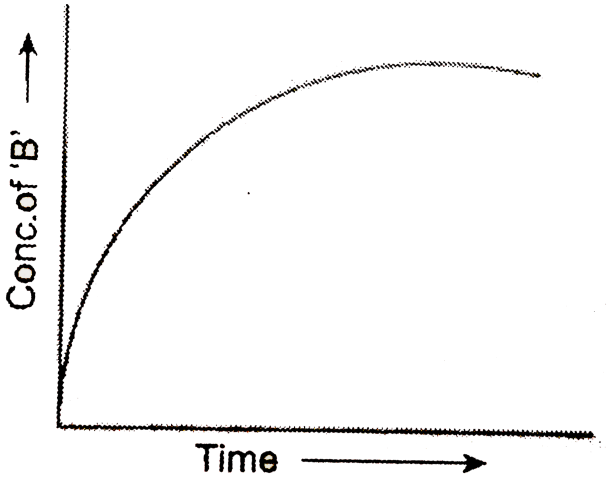
30. The graph given below shows the change in comcentration of 'B' with time for the reaction $A \rightarrow B$. Identify the steps given below in sequence for determining instantaneous rate.

(1) Find the slope of y-axis, that is $y_2 - y_1$ gives change in concentratino of 'B' , whereas change in the x-axis, that is

$x_2 - x_1$ gives a small change in time interval.

(3) Slope of the tangent is equal to instantaneous rate.

(4) Draw the tangent on the curve at a particular instant of time 't'.



A. 3,1,2,4

B. 1,2,3,4

C. 4,2,1,3

D. 4,3,1,2

Answer:

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31. For the reaction $A \rightarrow B$, identify the correct sequence of steps for the calculation of average rate of reaction.

(1) plotting a graph of concentration of 'A' at various time intervals.

(2) identification of C_2 and C_1 at different time interval t_2 and t_1 , respectively by reading the graph

(3) Calculation of $\frac{C_2 - C_1}{t_2 - t_1}$

(4) finding out the experimental values of concentratiions of 'A' at regular intervals

A. 4,2,3,1

B. 4,1,2,3

C. 3,2,1,4

D. 1,2,3,4

Answer:

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32. Initial number of moles of reactants taken in a closed reaction vessel is given. Percentage degree of dissociation is also given . Identify the correct sequence of steps to calculate k_c value.

(1) calculation of equilibrium concentrations of reactants and products

(2) calculation of equilibrim concentration number of moles

(3) writing equilibrium constant expression for the reaction

(4) calculation of k_c value by using the equilibrium concentration

A. 4,2,3,1

B. 2,1,3,4

C. 3,2,1,4

D. 2,1,4,3

Answer:

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33. Which among the following reactions is an example of instantaneous reaction under normal conditions ?

A. $2H_2 + O_2 \rightarrow 2H_2O$

B. $N_2 + O_2 \rightarrow 2NO$

C. $NaOH + HCl \rightarrow NaCl + H_2O$

D. $C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

Answer:

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34. The rate of the reaction between ionic compounds cannot be determined because they are generally

A. immeasurably slow reactions

B. moderately slow reactions

C. instantaneous reactions

D. not precipitation reaction

Answer:

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35. For a reaction $A + B \rightarrow C$, the rate law is written as $r = k[A]^2[B]$. Doubling the concentration of 'A' without changing concentration of 'B' increases the rate of reaction by

A. 2 times

B. 4 times

C. 8 times

D. 16 times

Answer:

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36. Identify the common property for a chemical reaction at dynamic equilibrium

A. The measurable properties like concentration , density , colour, pressure , etc. , remain constant at constant temperature .

B. The forward and backward reactions take place with the same rate.

C. It can be achieved from both directions

D. all of the above

Answer:

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37. Which of the following k_c values corresponds to the maximum yield of the product ?

A. 9.2×10^2

B. 1.8×10^{-15}

C. 2.8×10^3

D. 3.4×10^{-25}

Answer:

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38. For a reaction $A + B \Leftrightarrow C + D$, if the activation energy of backward reaction is more than that of forward reaction, the forward reaction is

A. endothermic

B. exothermic

C. reaction need not necessarily involve heat changes

D. cannot be predicted

Answer:

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39. According to Le Chatelier's principle,

A. an increase in pressure always causes a change in position of equilibrium for any reaction

B. the yield of NH_3 decrease from its constituents at lower temperature

C. an increase in temperature causes a decrease in the value of Kc for an exothermic reaction.

D. the k_c is decrease for the reaction $A_{(s)} + B_{(g)} \rightarrow C_{(g)}$, if the concentration of A is increased

Answer:

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40. In which among the following reactions, the formation of product is favoured by decreasing the temperature or volume ?

A. $2SO_{3(g)} \Leftrightarrow 2SO_{2(g)} + O_{2(g)} - q$

B. $N_{2(g)} + O_{2(g)} \Leftrightarrow 2NO_g - q$

C.

$4NH_{3(g)} + 5O_{2(g)} \Leftrightarrow 2NO_{(g)} + 6H_2O_g, \Delta H = -ve$

D. $2NO_{(g)} + O_{2(g)} \Leftrightarrow 2NO_{2(g)}, \Delta H = -ve$

Answer:

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41. The rate of a reaction depends on the

A. temperature of the reaction

B. catalyst

C. concentration of the reactants

D. all of these

Answer:

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42. If the formation of NO and O_2 from NO_2, the rate of production of

A. NO and O_2 are equal

B. NO is double the rate of consumption of NO_2

C. NO is twice the rate of production of O_2

D. O_2 is twice the rate of production of NO

Answer:

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43. For a reaction $A + B \rightarrow C$, the rate law is written as $r = k[A]^2[B]$. Doubling the concentrations of both of 'A' and 'B' increases the rate of reaction by

A. 2 times

B. 4 times

C. 8 times

D. 16 times

Answer:

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Level 2

1. Nitrogen dioxide gas dissociates to give nitric oxide and oxygen. For this reaction, when a graph is ploted between concentration of NO_2 and time, the slope of tangent drawn at time t=10 s is found to be 6.8×10^{-4} mol $L^{-1}s^{-1}$ .predict the slope of the graph at t=10s when the concentration of NO and O_2 are plotted against time. Justify your answer.

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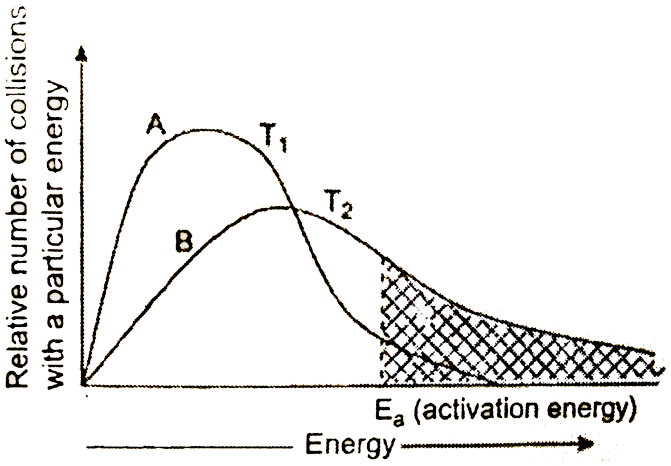
2. Based on the following curves predict in which case the rate of reaction would be more and justify ?



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3. Hydrogen peroxide decomposes into water and oxygen. The uncatalysed reaction has activation energy of 86 KJ/mol . The E_a value in the presence of acetanilide is 112 KJ/mol

and in the presence of MnO_2 it is 49 KJ/mol. What conclusion can you draw from the above observations ?

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4. In the decomposition , $2N_2O_5 \Leftrightarrow 4NO_2 + O_2$ oxygen gas is produced at the average rate of 9.1×10^{-4} mol $L^{-1}s^{-1}$. Over the same period what is the average rate of production of NO_2 and loss of N_2O_5

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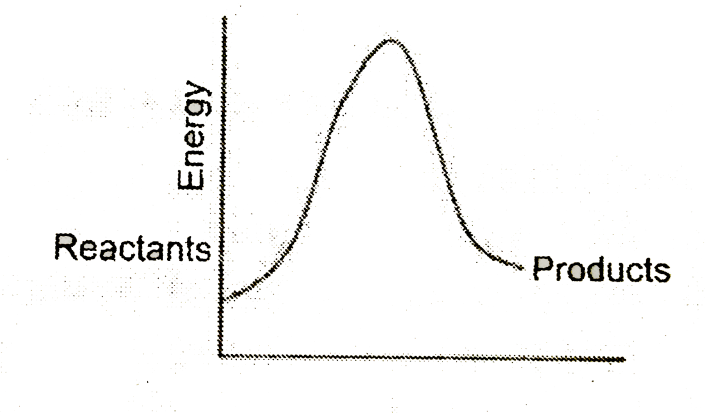
5. Energy profile diagram for a reversible chemical reaction is given . On the basis of the given diagram , explain the

effect of temperature on the equilibrium



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6. For a reversible reaction, the activation energy of a forward reaction is 85 KJ/mol . The net reaction is assoicated with the release of 15 KJ/mol . What is the activation energy of the backward reaction ? Explain it on the bais of the collision theory ?

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7. On what factors do the equilibrium position and equilibrium constant depend ? Explain by giving appropriate reasons .

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8. In a gas phase reaction , the decomposition of PCl_3 takes place at $273^\circ C$ and 1 atmosphere pressure. It percentage degree of dissociation is 40 per cent . Assuming that all gases in the reaction behave ideally, calculate the density of the equilibrium mixture. [atomic weight of phosphorus =3 and chlorine=35.5]

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9. Carbon monoxide and water vapor react to give Co_2 and H_2 in a vessel of 2 L capacity at 1090 K . Equilibrium is established and the number of moles of various components is found to be 0.8,0.6,0.4 and 1.2 mol , respectively. Calculate K_c value. 1.2 mol by increasing the concentration of CO_2 at the equilibrium , find the number of moles of CO_2 to be added to the reaction mixture at the same temperature.

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10. For a gas phase reaction $Cl_2 + CHCl_3 \rightarrow HCl + \mathrm{CCl}_4$, the rate law is given as $r = k[Cl_2]^{1/2}[CHCl_3]$. Explain how the rate of reaction

varies when the concentration of chlorine is doubled . Give units of rate constant

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11. $BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$

The order of reaction with respect to BrO_3^- is 2 and with respect to other reactants is one. Complete the following table.

	BrO_3^-	Br^-	H^+	Initial rates
I	0.1	0.1	0.1	?
II	0.2	0.1	0.1	1.6×10^{-3}
III		0.2	0.1	3.2×10^{-3}
IV	0.1	0.1	0.2	?

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12. A reaction takes place in two steps. The rates of the two elementary steps are given. On the basis of these, predict the rate of reaction with changes in concentration. Also the given units of rate constant are

$2A_{(g)} + B_{2(g)} \rightarrow 2AB_{(g)} \rightarrow$ Overall reaction

$A + B_2 \rightarrow AB + B$ in the first step, r $= 3.2 \times 10^4$ mol $L^{-1}s^{-1}$

$B + A \rightarrow AB$, in the second step , $r = 1.9 \times 10^6$ mol $L^{-1}s^{-1}$

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13. A chemist was studying the reaction of type $2A_{(g)} + 2B_{(g)} + C_{(g)} = 2D_{(g)}$ experimentally . He found out that the order of the reaction is 2. Complete the

following table based on the experimental results given by him.

	[A]	[B]	Rates (mole $L^{-1} s^{-1}$)
(i)	5×10^{-3} M	2.5×10^{-2} M	3.0×10^{-5}
(ii)	15×10^{-3} M	2.5×10^{-2} M	9.0×10^{-5}
(iii)	15×10^{-3} M	..... M	7.5×10^{-6}
(iv)	1.25×10^{-3} M	2.5×10^{-2} M	.....

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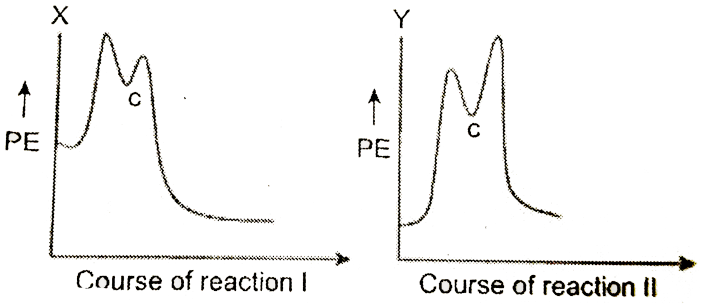
14. Energy profile diagrams for hypothetical reaction $2A_{(g)} + B_{(g)} \rightarrow 2D_{(g)}$ and $X_{2(g)} + Y_{2(g)} \rightarrow 2XY_{(g)}$ are given below. Predict the slow and fast steps from these two reactions. Also identify the factors that favour the

formation of reactants from products. Justify.



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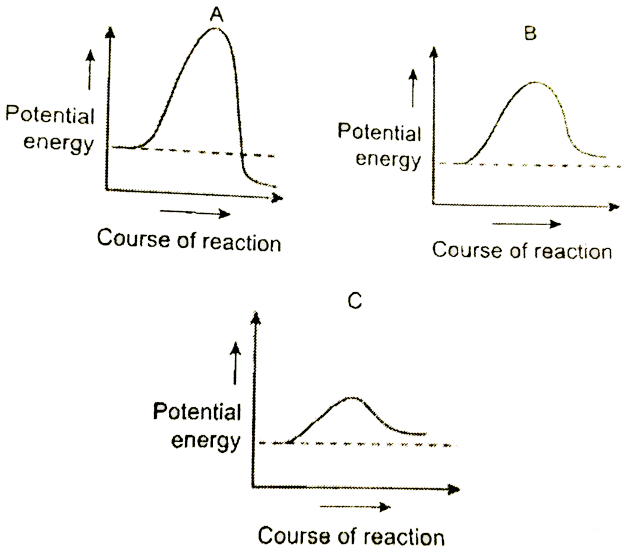
15. From the three energy profile diagrams A,B and C, find out which of the above irreversible reactions gives maximum yield within a given period of time ? Justify. [Consider that the initial concentration of the reactants

and temperature is same for all the reactions.]



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16. Why is the reaction of SO_2 to SO_3 not rapid ini clean and dry air ?

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17. Change in temperature results in change in equilibrium position . However, the addition of a catalyst results in no change in the equilibrium position . Justify.

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18. $Ag_2S + 4NaCN \Leftrightarrow 2Na\left[Ag(CN)_2\right] + Na_2S$. Oxidation of sodium sulphide formed is the important step in the extration of silver from its ore . Justify.

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19. An absent-mined prodessie, Mr Waage, took elements A and B in a reaction vessel at room temperature, to study the reaction $A + 2B \Rightarrow 2C + D.$ He took the

concentration of B as 1.5 times the concentration of A. After the reaction reached equilbrium, he round that the concentrations of A and D were equal. However, he forgot to calculate K_c and removed oneof the products from the mixture. Now, can you calculate K_c for the equilibrium attained in his experiment and help him out ?

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20. When 2.82 g of solid NH_4Cl is intoroduced into a 2 L flask at $30^\circ C$. 40 per cent of the solid NH_4Cl decomposes into two gaseous products, that is NH_3 and HCl. Calculate the Kc. What would happen if more amount of NH_4Cl is introduced into the flask ?

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21. 0.5 moles of CO thken in a 2 L flask is maintained at 750 k in the presence of a catalyst so that the following reaction can take place: $CO + 2H_2 \Leftrightarrow CH_3OH$. When hydrogen is introduced, the pressure of the system in increased to 23.629 antm from 15.129 atm at equilibrium and 0.08 moles of gaseous product, methanol is formed. Clculate k_C.

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22. A mixture of 0.75 mol of N_2 and 1.20 mol of H_2 is placed in a 3 L container. When the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ reaches the equilibrium, the concentration of H_2 is 0.1 M. Calculate the concentration of

N_2 and NH_3 when the reaction is carried out with double the number of moles.

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Level 3

1. What is the use of catalytic convertic in automobile exhaust systems ?

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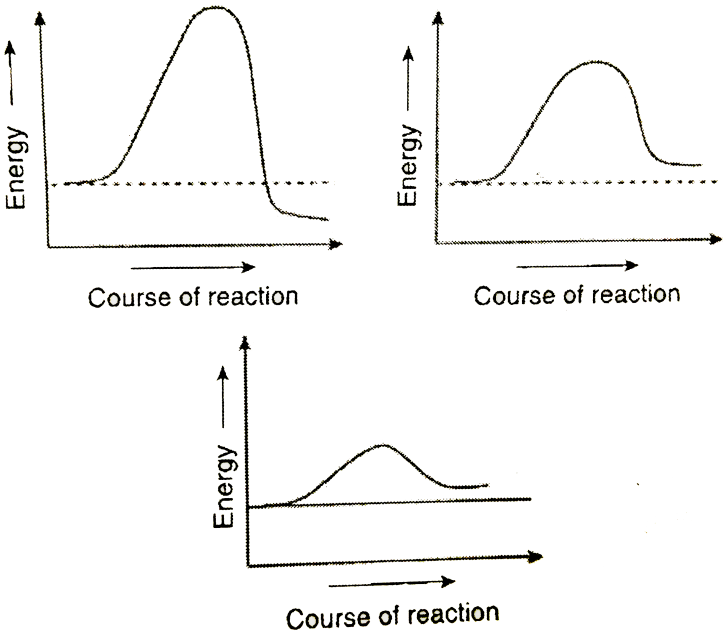
2. From the above three energy profile diagrams find out which of the above irreversible reactions gives maximum yield within a given period of time ? Justify. [Consider that

the initial concentration of the reactants and temperature is same for all the reactions.]



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3. The decomposition reaction $N_2O \rightarrow N_2 + O_2$ takes place on platinum surface. Here, the rate of reaction is independent of the concentrations of the reactant .

However, when this reaction is carried out in the absence of platinum surface, the rate of reaction depends on the concentration of the reactant How do you account for this ?

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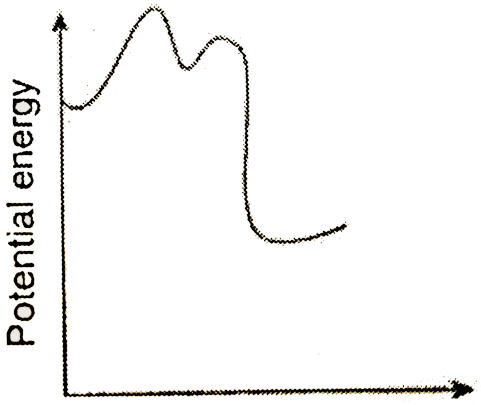
4. Energy profile diagram for a two-step reaction is given. On the basis of given diagram, predict the slow and fast steps in the reaction. Explain it on the basis of collision theory. Predict the factors that favour the formation of

reactants from the products.



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5. Explain the effect of addition of CO and O_2 and solid carbon to the equilibrium mixture separately. Also explain the effect of addition of all the three simultaneously . What happens to the equilibrium when the above changes are carried out in a container having less volume ?

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6. A 1 L reaction vessel contained 1 mole each of solid NH_4HS, $NH_{30 \text{ and } H_2S}$ at a temperature of $150^\circ C$. When the decomposition of NH_4HS was carried out , equilibrium is established K_p value at that temperature is 100. Calculate the equilibrium partial pressures at which 60 per cent dissociation of NH_4HS takes place at a lower temperature where K_p value is equal to 200 atm^2 .

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7. Under what conditions , addition of insert gas affects the equilibrium position in case of the following equilibrium at constant temperature . Give a reason in support of your answer.

(a) decomposition of NO to N_2 and O_2

(b) decomposition of SO_3

(c) formation of CH_3OH from CO and H_2

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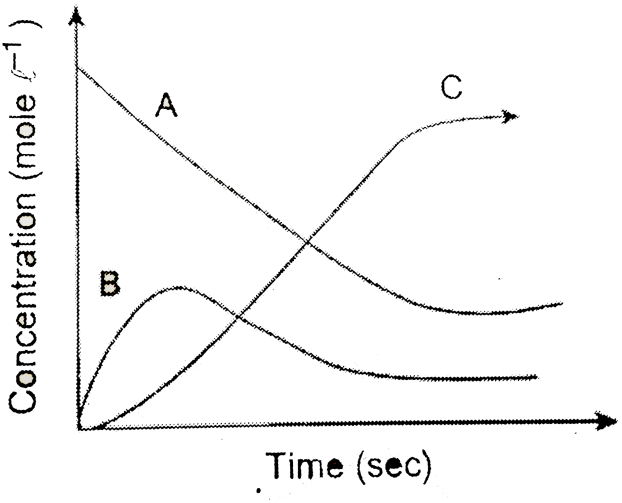
8. In a reaction , A is converted to C with the formation of an intermediate B. On the basis of the given graph compare

the rate constatns.



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9. Nitric oxide can catalyse ozone formation in troposhere .

Justify.

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10. Carbon monoxide and water vapour react to give CO_2 and H_2 in a vessel of 2 L capacity at 1090 K. Equilibrium is established and the number of moles of various components is found to be 0.8, 0.6, 0.4 and 1.02 respectively. Calculate K_c value. If the concentration of CO has to be increased to 1.2 mol by increasing the concentration of CO_2 at the equilibrium , find the number of moles of CO_2 to be added to the reaction mixture at the same temperature.

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